

Original Research Article

The Analysis of Risk Factors for Periprosthetic Joint Infection in Indian Hospital Settings

Madhav Madhusudan Singh¹, Munish Sood², Akshay Kumar Sharma^{3*}, Manish Parsad⁴, Saurabh Mahajan⁵, Kamparsh Thakur⁶

¹Department of Hospital Management, Indian Field Hospital Level 2, United Nations Mission

²Department of Orthopaedics, Indian Naval Hospital Ship (INHS) Asvini, Mumbai

³Department of Orthopaedics, Military Hospital, Jaipur

⁴Department of Orthopaedics, Indian Field Hospital Level 2, United Nations Mission

⁵Military Hospital, Jammu

⁶Department of Orthopaedics, National Health Service (NHS), Birmingham

*Correspondence: Dr. Akshay Kumar Sharma (akshaysharma5570@gmail.com)

ABSTRACT

Background: Periprosthetic Joint Infection (PJI) is a nightmare for both patient and surgeon. Despite advances made in arthroplasty still incidence is 1-2%. Many of our understanding regarding PJI come from registry data. Despite performing large number of joint replacement surgeries there is a lack of optimal registry data from this part of world. We retrospectively analysed PJI data in four NABH accredited hospital of around 5370 patients and tried to identify common risk factors in them and proposed a clinical scoring system for assessing risk of PJI.

Materials and Methods: The study population was patients requiring surgical intervention in the form of arthroplasty. PJIs were defined as patients requiring procedure at the operated site within 2 years of index surgery. We retrospectively analysed patients' data from hospital records and lab investigations done at the time of surgery.

Results: We found that statistical significant risk factor in our study were number of joint replacement performed, poor blood glucose and serum albumin, increase duration and complexity of surgeries, Rheumatoid Arthritis (RA), Chronic Kidney Disease (CKD) and chronic liver disease and use of allogenic blood transfusion. Relative risk (RR) of diabetes (RR 2.4), liver disease (RR 1.6), connective tissue and rheumatic diseases (RR 1.5), serum albumin (RR 2.1), allogenic blood transfusion (RR 2.3), Increase duration for surgery (RR2.1), CKD (RR1.3) was there with PJI.

Conclusions: Our research consistently identified the most significant risk factors for PJI across all cases. We propose a patient-based scoring system to estimate individual PJI risk. By addressing modifiable risk factors before joint replacement, we can potentially reduce the incidence of PJI.

Keywords: Arthroplasty, Periprosthetic Joint Infection (PJI), Risk Factors

INTRODUCTION

Prosthetic Joint Infections (PJI) is a devastating complication after successful joint replacement surgeries. PJIs are one of the major causes of revision

arthroplasty surgeries worldwide. In various studies incidence of PJI has been shown to be associated with 1 to 2% of joint replacement surgeries and is a frequent cause for revision.^{1,2} PJIs despite being one of the dreaded complications are difficult to diagnose. In an attempt to diagnose this better, the

musculoskeletal infection society has given criteria, however the ambiguity in diagnosing still persists. There is a lack of relevant clinical scoring system which helps in having a strong suspicion of infection in ambiguous patients. In our study we have proposed a scoring system based on preoperative and intra-operative risk factors, which can help in the diagnosis of this complication.

The data regarding periprosthetic joint infections can help us improve our understanding regarding measures required for improving outcomes at the time of primary surgery.^{2,3} The nationwide large data registries can also help us in identifying risk factors which can be modifiable or non-modifiable. Therefore, it has a direct bearing on improving our protocols. Further, the compiling and assessment of data requires accurate reporting. Presently all our understanding and literature are derived from arthroplasty registry data from developed countries. Despite large number of joint replacement surgeries performed in India, no reliable arthroplasty registry is available with us. Hence, most of our understanding and management of this dreaded complication is from developed world's perspective. In our study we have analysed the incidence of infections in four major National Accredited Board of Hospitals (NABH) accredited hospitals of India. We have also analysed the most significant risk factors associated with PJI and tried to provide a framework on which national joint registry can be made.

MATERIALS & METHODS

Between January 2018 and December 2021, the first author collected the data of arthroplasty surgeries performed at the four major NABH accredited hospitals of India. Total of 5370 arthroplasty surgeries were performed during same period, of which 3265 were knee replacements; while rest were total replacements or hemi-replacements of the hip. The infection rate was assessed for at least two years in this cohort.

The study population was patients requiring surgical intervention in the form of arthroplasty. PJIs were defined as patients requiring some intervention at the operated site within 2 years of index surgery. Revision surgeries, partial knee replacement surgeries were not included. However, bilateral surgeries or if patient had more than one joint operated during the above period, these procedures were included as two discrete procedures.

After doing literature review of western studies, commonly documented risk factors were poor glycemic control HbA1c>7.5, poor albumin <2.5g/dl, history of allogenic blood transfusion, presence of comorbidities like Rheumatoid Arthritis (RA)/ Chronic Kidney Disease (CKD) and volume of surgeries performed at centre also impact PJI rates.^{1,2,3} We retrospectively analyzed patients' data from hospital records and lab investigations done at the time of surgery. In case of delayed presentation of PJI during our study fresh glycemic control and serum albumin levels were investigated.

We assess the relative risk of various factors by Pearson's correlation coefficient and propose a scoring system depending upon most significant factors in our study. Finally, we retrospectively analysed effectiveness of our scoring system. We checked the incidence of infection in presence of one vs. more risk factors. We have analysed the data retrospectively and all investigations and treatment were given as per current accepted practices, hence no ethical clearance was required.

We propose a classification system as in table 1 given below depending upon relative risk of all factors retrospectively.

Table 1: Proposed scoring system

Risk factor		Scoring
Serum albumin <2.5g/dl		2
Increase duration of surgery >2.5 hrs		2
Poor glucose control, HbA1c >8		2
Allogenic blood transfusion		2
Comorbidities	RA	1
	CKD	1
	Chronic Liver Disease	1
Total score		11

RESULTS

Out of total surgeries performed (n=5370), 3265 were total knee arthroplasties while 1243 were total hip replacements and 862 were hemi-arthroplasties of hip. The average age of these patients was close to 65. There were 1908 male patients while the rest were (3462) female. Approximately 800 patients were ASA grade 1, 3400 patients were ASA grade 2, while rest were ASA grade 3. Approximately 50% of patients had one comorbidity while 20% had two

comorbidities, while less than 5% had 3 or more comorbidities.

Thirty nine re-surgeries were performed for PJI. In 15 patients it was superficial Surgical Site Infection, (SSI) while in 24 it was deep SSI at the time of presentation. In 12 cases debridement and wash was done, in 7 cases modular component exchange was done, in 19 cases staged revision surgery was done, while in 1 case excisional arthroplasty was done.

While analysing various risk factors, we found infection was more in centres where less than 200 total joint replacements were performed as compared to centres where number of joint replacement surgeries performed was more than 200. Other significant risk factors associated were serum albumin < 2.5g/dl, duration of surgeries lasting more than 2.5 hours, use of allogenic blood transfusion, poor glucose control HbA1c <8.0 and associated comorbidities like RA/CKD/Chronic Liver disease. (Table 2) (Figure 1-6)

Pearson's correlation was used to assess association of various factors with reported infections. Overall it was seen that there was a significant correlation of number of infected cases reported after surgery when duration of surgery was more than 2 hrs, allogenic blood transfusion, poor serum albumin, poor glycemic control and in those with comorbidities ($p<0.05$). In cases which underwent hemi-replacements, there was a significant correlation of reported infection cases with poor serum albumin and patients with comorbidities ($p<0.05$).

While analysing various risk factors, we found that the relative risk of various risk factors was not significant as compared to other risk factors despite being significant than general population. It is evident by low scoring system 2-4. Risk of PJI increased significantly when more than 2 risk factors were present as evident by score more than 4. Our data also showed that patients who had score more than 7 had nearly 100% incidence of PJI.

Table 2: Distribution of patients with various factors

	Procedure	Number	Infection reported	Duration of surgery >2 hrs	Allogenic blood transfusion	Poor serum albumin <3.5 g/dl	Comorbidities	Poor glucose control; HbA1c <7.5
Median	Hemi	200	3.50	1.00	1.00	1.00	0.500	0.500
	Total	294	1.00	0.500	0.00	0.500	0.00	0.00
Standard deviation	Hemi	134	2.14	0.756	0.991	0.926	0.991	0.744
	Total	144	1.77	0.886	0.916	0.535	0.463	0.756

Figure 1: Number of surgeries and type of procedure

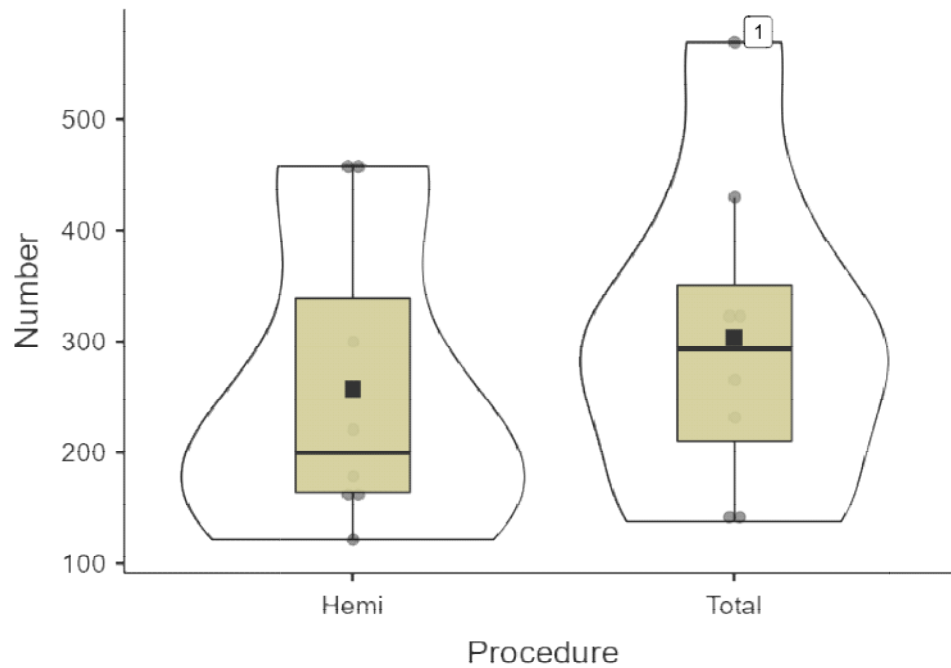


Figure 2: Infection reported and type of procedure

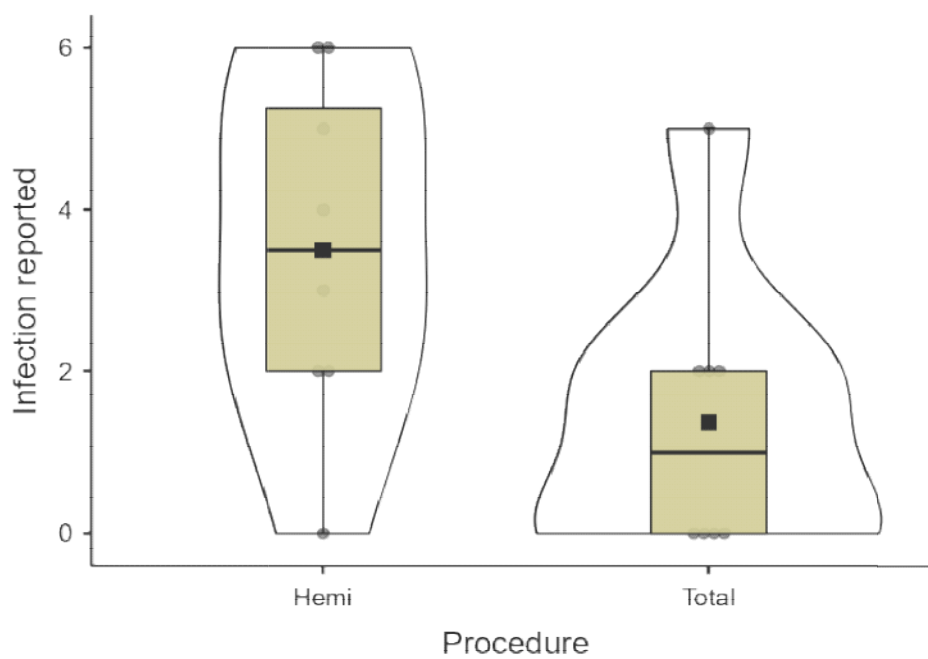


Figure 3: Duration of surgery >2 hrs and type of procedure

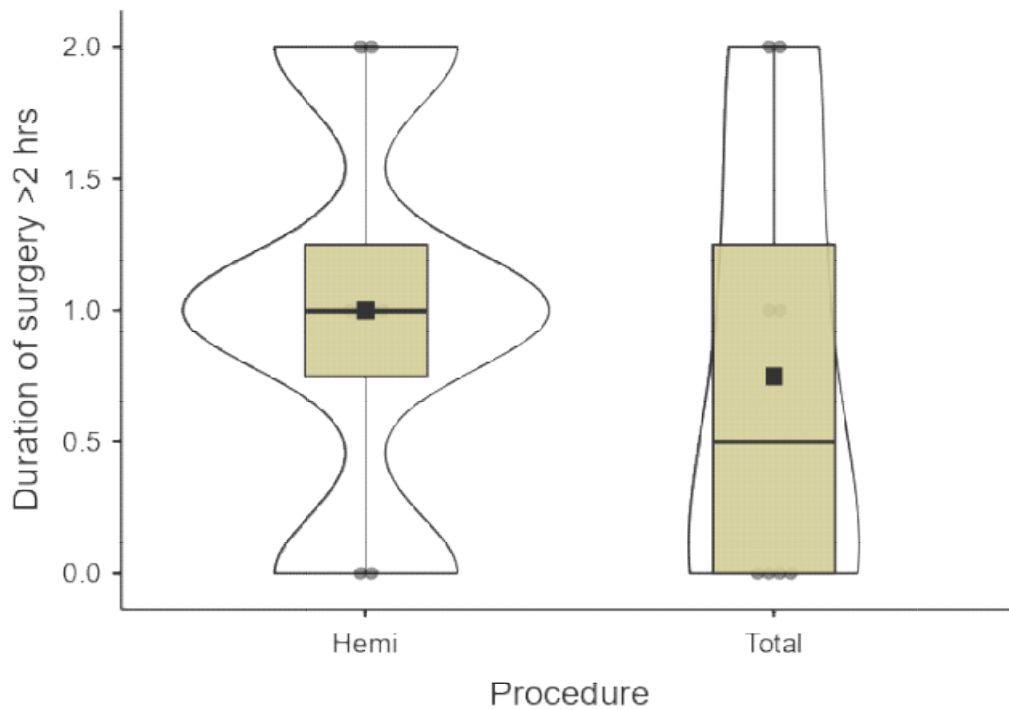


Figure 4: Allogenic blood transfusion and type of procedure

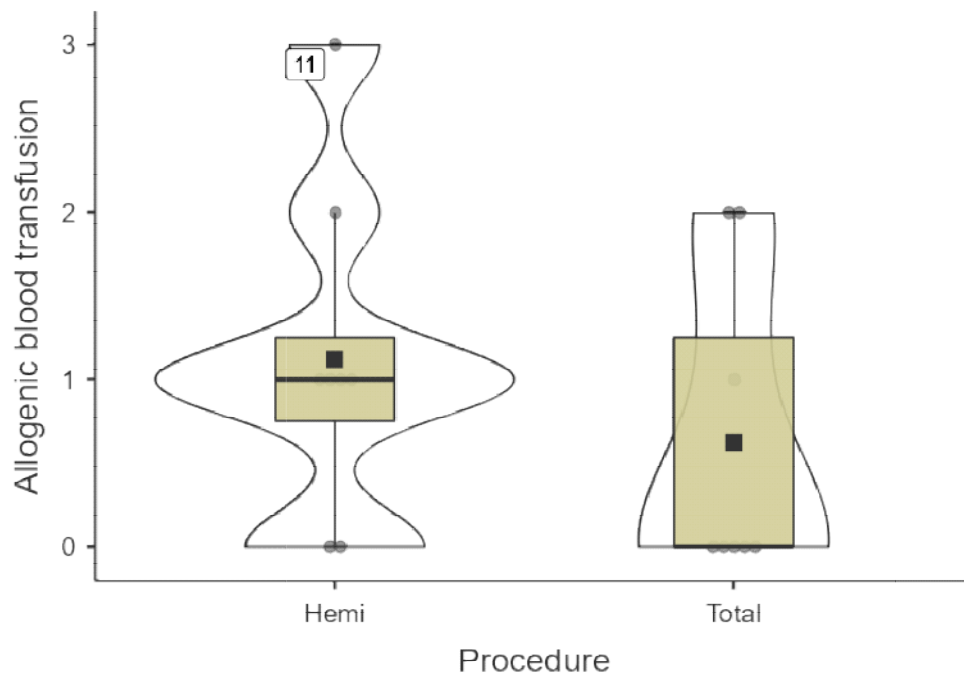


Figure 5: Poor serum albumin <3.5 g/dl and type of procedure

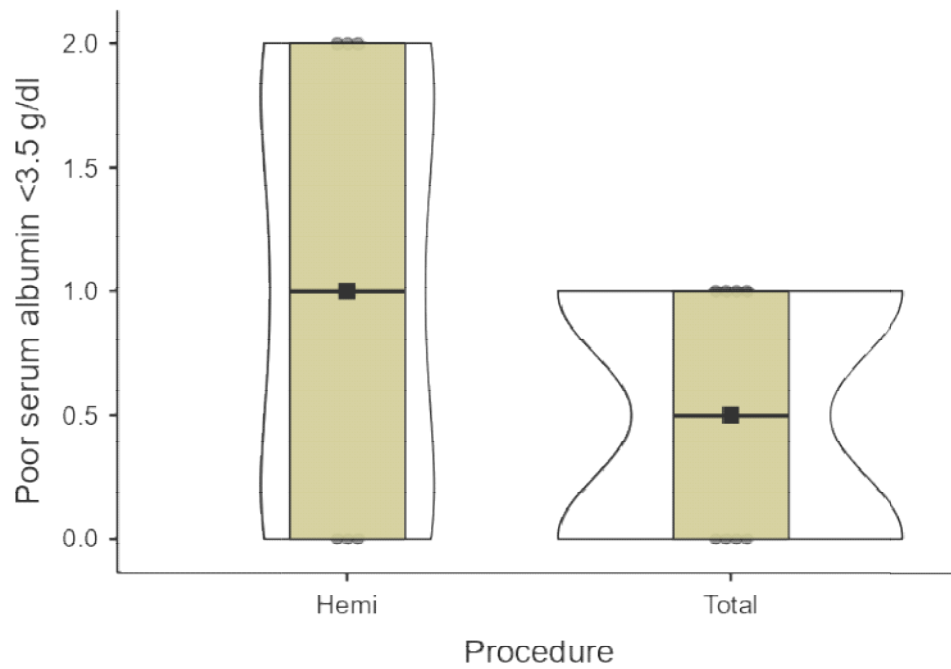
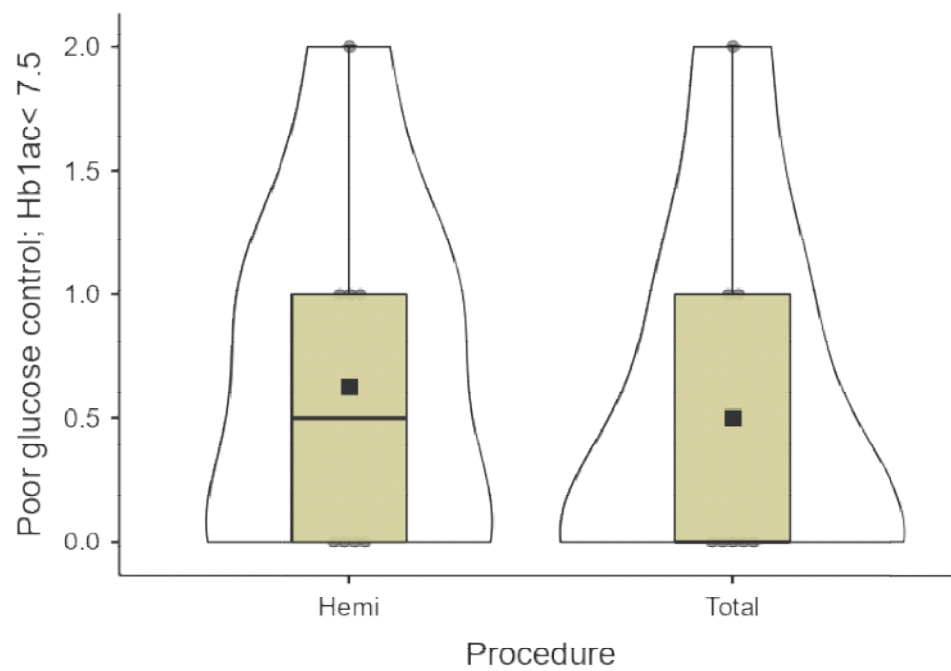


Figure 6: Poor glucose control; HbA1c>7.5 and type of procedure



DISCUSSION

Arthroplasty Registry data has contributed in terms of best practices to implant performance. However, despite large number of joint replacement surgeries performed in this part of world, we are still far behind in terms of any significant joint registry. Hence our study can become a pilot study for analysis of results of joint replacement surgeries. We collected data from 4 NABH accredited hospital and analysed the associated infection rates.

Total joint arthroplasty is considered as one of the most successful surgeries in terms of pain relief and restoring functions of the joint. PJIs are considered one of the most dreaded and devastating complications following joint replacement. The treatment of PJIs is long, requires re-surgeries and re-admissions.^{1,2} PJIs are great burden to the patients as well as to the society. Risk factors for PJIs are plenty and have been studied upon by various authors. These risk factors can be divided into patient related, surgery related as well as operation theatre related risk factors. It is very important to assess the various risk factors involved with PJIs so that rate of PJIs can be controlled. The infection rate in joint replacement in various joint registries is close to 1%.^{1,2,3} Similarly, the re-surgery rate because of infection was less than 1% in our study. However, there is no such data available from Indian subcontinent.

Lessons learned from national joint registry from UK and Danish showed us various risk factors associated with PJI. Risk factor has been stated from high volume to low volume centre, gender, poor patient preoperative sugar and proteins build up, higher duration and complexity of surgeries, use of allogenic blood transfusion and association of various comorbidities. Out of various risk factors we found that statistically significant risk factor in our study were number of joint replacement performed, poor blood glucose and serum albumin, higher duration and complexity of surgeries, rheumatoid arthritis, chronic kidney disease, chronic liver disease and use of allogenic blood transfusion. Relative risk of diabetes (RR 2.4), liver disease (RR 1.6), connective tissue and rheumatic diseases (RR 1.5), serum albumin (RR 2.1), allogenic blood transfusion (RR

2.3), Increase duration for surgery (RR2.1), CKD (RR1.3) was there with PJI.

Many studies have shown that there is relation between PJI and volume of surgeries performed. Data from UK registry has showed greater number of revision surgeries for PJI performed at high volume centres; however, our study had opposite findings.² In centres performing less than 200 joint arthroplasties the infection rates seem to be much as compared to high volume centres. One plausible explanation of this might be a better trained operating room team in high volume centres because of doing similar kind of cases routinely and due to better laid down guidelines at these centres.

Diagnosis of PJI is difficult. We usually follow CRP monitoring for infections; however, it can be raised after 2-3 weeks of surgeries and can also be elevated in other unrelated illnesses. Musculoskeletal society infection score (MSIS) has been proposed in 2018 for diagnosis of infection and later Bone involvement, Anti-microbial options, Coverage of the soft tissues, Host status (BACH) classification system has been suggested.⁴ Few drawbacks of this scoring system are evaluation of frozen section and need of lab facility for decision making. Hence, we propose a classification based on factors listed above to act as a screening tool for PJI. We retrospectively analyzed effectiveness of this scoring system and found that with increasing score the rate of infection is much higher. Being a patient, based score it can be applied easily in any setting and in correlation with rising CRP values can be highly sensitive for infection.

CONCLUSIONS

A significant gap exists in reliable joint registry data across the Indian subcontinent, despite the substantial volume of joint replacement surgeries performed. Unlike the UK, which has standardized guidelines like GRIFT, a similar framework is absent in our region. Previous studies have identified diverse sets of risk factors associated with Periprosthetic Joint Infection (PJI). Our research consistently revealed the most significant risk factors across all cases. Based on these findings, we propose a patient-based scoring system to estimate individual PJI risk. This tool can

inform patient counselling, enhance surgical precautions, and facilitate vigilant postoperative monitoring, ultimately minimizing intervention requirements. By addressing modifiable risk factors prior to joint replacement, the incidence of PJI can be potentially reduced.

REFERENCES

1. Sabah SA, Alvand A, Price AJ. Revision knee replacement for prosthetic joint infection: Epidemiology, clinical outcomes and health-economic considerations. *The Knee*. 2021 Jan 1;28:417-21.
2. Lenguerrand E, Whitehouse MR, Beswick AD, Kunutsor SK, Foguet P, Porter M, Blom AW. Risk factors associated with revision for prosthetic joint infection following knee replacement: an observational cohort study from England and Wales. *The Lancet Infectious Diseases*. 2019 Jun 1;19(6):589-600.
3. Jämsen E, Huhtala H, Puolakka T, Moilanen T. Risk factors for infection after knee arthroplasty: a register-based analysis of 43,149 cases. *JBJS*. 2009 Jan 1;91(1):38-47.
4. Hotchen AJ, Wismayer MG, Robertson-Waters E, McDonnell SM, Kendrick B, Taylor A, Alvand A, McNally M. The Joint-Specific BACH classification: A predictor of outcome in prosthetic joint infection. *E Clinical Medicine*. 2021 Dec 1;42.

Source of funding: None

Conflict of interest: None declared

How to cite: Singh MM, Sood M, Sharma AK, Parsad M, Mahajan S, Thakur K. The Analysis of Risk Factors for Periprosthetic Joint Infection in Indian Hospital Settings. *GAIMS J Med Sci* 2025;5(1):6-13.

<https://doi.org/10.5281/zenodo.13773027>